Menlo Park Notebook #16 [N-79-01-21]

This notebook covers the period January 1879-March 1880. The entries are by Edison, Charles Batchelor, Francis Upton, John Kruesi, and Charles P. Edison. The name of Martin Force appears as a witness. All of the material relates to experiments on electric lighting and on the telephone. The electric light material includes notes and drawings of lamps; notes on filaments; notes, drawings, and calculations about generators; calculations relating to electric power distribution systems; notes by Batchelor on the cost and design of steam engines and boilers; and notes by Kruesi on the design of the central station for Menlo Park and the extension of the machine shop to house it. The telephone material includes notes and drawings by Batchelor and Charles Edison; notes by Batchelor on parts and prices for the telephone; and notes by Kruesi on making and packing the telephone receiver. The book contains 280 numbered pages.

Blank pages not filmed: 236-237.

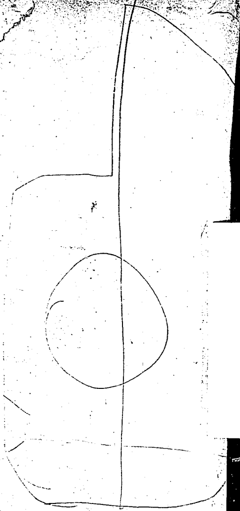
[illegible]

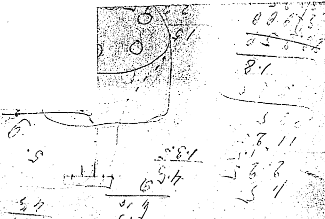
Edison Laboratory Note Book No..16.

Pages 1 to 41.

Platinum & other metals, & metallic oxi.

nts:





8.1

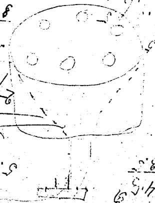
120 BROADWAY, NEW YORK.

[illegible]

[illegible] St. N.Y.C.

[illegible], 189

[illegible] of [illegible]



266) 5.00 (300
798
2000

266) 17.00 (639
1596
1040
798
2420

266) 17.00 (07
1862

266
265

265) 1.000 (.00377
795
2050
~~25~~
1855
1950

.00347 % lost in 20 minutes

in next 20 minutes

.00377
3
.01131

total .00377
.01518

60 minutes .00377
2
20 minutes .00754
.01518
80 .02272
.00754
.03026
100 .01131
.04157
120 .01131
.05288
140 .01131
.06419
.01131
.07550

37594
.0266.) 1.000 (.0037594
798
2020
~~96~~
1862
1580
1330
2500
2394
1060

37594
3
112782
X4 150376
X2 75188
225564

.0132

266
249
17

266) 23.50 (84
2128
1220

266) 17.00 (6
1596
1040

Minutes	% loss during	Total
20	.003	.003
40	.011	.015
60	.007	.022
80	.007	.030
100	.011	.041
120	.011	.052
140	.011	.063
160		
4 240		.084
4th 20' 260		.084

210
157
53
36
18

157
121
103

.0625
3.2
.9
.575
.0625

.0625
16

.0312
.0312
.0624
.0655

Pipeclay Jan 21st 1879

~~Chas Batchelor~~
Martin N Force.

Made piece of pipe clay
1.75 X .937

dried for 48 hours and it measured
1.655 X .875
put in oven at 320° Fahr and baked for
3 hours then measured

Pure Nickel   Jan 23 1879

C Batchelor
M N Force

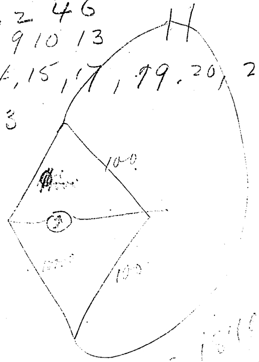
Took a piece ~~110~~ [illegible]

7mm X 2½mm square ~~[illegible]~~

Soften [illegible]

Fuses

1. 2 4 6
7 9 10 13
14, 15, 17, 19. 20, 22,
23



Aug 23 1916

Scheelite Ca. group Fuses Ox H yellow. Ph

27 Diopsite fuses

~~28 Mag~~ ~~Mn Group~~ magnesium group

28 ~~Magnesite~~ fuses
Prehnite Ca grp

Mg magnesium grupp
29 Magnesite Infusible

31 S. Feldspathite fuses
32 Talc fuses
33 Tremolite fuses
34 Pyrope fuse
35 Serpentine fuses

Al. Jany 23 1899

Tag

36 Corundum almost infus.

37 Diaspore fusible

38 Fibrolite in

39 Kyanite in

40 Kaolinite in

41 Pyrophyllite ..

42 Topaz in

Be 43 Beryl in

Y. Ta

44 Yttrotantalite fusible

Zr Jany 23 1879

45 Zircone TqE1 fusible

Ce

46 Cerite

47 Mn. Hausmannite fusible

48. Psilomelane

49. Pyrolusite Dont fuse
felt [illegible] any fusion
probably C in [illegible] E.

50. Franklinite

Mn Jany 23 1879

		Tag
51	Rhodonite ~~Arsen Iron~~	fusible
~~52~~	~~Fe~~	
52	Arsen Iron	fusible
53	Iron pyrites	" "
54	Magnet Iron	" "
55	Haematite	"
56	Limonite	fusible
57	Spec Iron	"
58	" " Micaceous	Infus-
~~59~~		

Cr Jany 23 1879

TAE

59 Chromic Iron Infusible

60 Vivianite fuses

61 Spathic Iron " "

W.

62 Wolfram fusible with great difficulty if the impurities are out think infusible E.

Ti

63 Titanif Iron fusible

V

64 Vanadium fuses

Co

65 Speiscobalt fusible smells like as.

Jany 23 1879
TAE

Co	66	Earthy Cobalt	fusible
Ni	67	Copper nickel	fusible
	68	Chathamite	"
Zn	69	Blend	"
Cd	70	Blend cadmiferous	" deflagrates
Z	71	Zincite	fuses.
	72	Calamine	in
	73	Willemite	fuses

Pt Jany 23 1879
TAE

74 Cerusite fuses with difficulty

75. ~~Pyromo~~rphite fusible

76 Galena "

77 Molybdenite
fusible with diff. gives
a splendid light, does not
apparently fuse after having
been fused E.

Sn
78 Tin stone

79 Tin pyrites

144 00008
6
864

98

Bi Jany 23 1879

80 Nat. Bismuth TAE
fusible, infusible after
fusion

81 Telluret
U [illegible] not work

82 Pitchblende

Cu.

83 Cu fusion

84 "

85 "

86 Cu pyrites "

87 Cuprite "

88 Azurite "

Jany 23 1879

89 Tal fuses

90 Chrysocolla fuses

Hg 91 Cinnabar

combines with Cu

92 N.G.

93 Gold fuses

94 Pt "

Mo 95 Molybdenite fuses

96 As fuses

97

98

Jany 23 1879

Tas fuses

99 B Tincal

100 Quartz

---

5 M.C. cold
" hot

---

29 M.C. cold
" hot

---

8 M.C. cold hot

---

11 M.C. Cold hot

---

12 M.C. Cold hot

25 NC. Cold hot

Jany 23 1879

TAE

---

18 N.G.

---

21 N.G.

---

22 N.G. on extremely small.

---

36. N.G.

---

82 NC cold very little heated goes off the scale. For investigation.

---

80 N.G.

59 Chromic Iron Jany 23 1879
slight C when cold better TAE
when hot poor conductor
stands a great heat

---

58. NG [illegible]
conductor

---

57 N.G.

---

62 N.G.

---

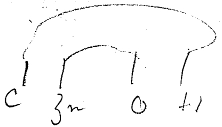
74 N.G.

D = 43° Jany 23 1879
42°.5 TAE

46°.5 to bring to the same as No. 1 when in a vacuum

51°0

36



1,15) 2.74 (2.[illegible]
2 30
440

37

Reddish yellow with air
22°

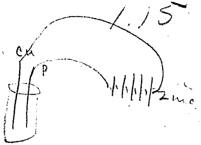
Yellow in vac Jany 23 1879
TAE

Small red 17°

Voltameter 49° 1,15

Without 70° 2.74

2,74


1.15
Cu
P
2 in c

3/4
1/4
3/4
1/4
2.1

2 1/8 3 1/4

10.5 in

[illegible].0001

3.141592

700.

10.5
.07
.735

3.14159
.0735
1570795
942477
03

10.5 in

~~003~~

.020

3.1415
.02
.062830
10.5

3.1415

3.14
.12
.3768
~~65 .65~~
1850
~~222~~
.2405

.120

.65

$\frac{1}{4}$

72 can

$\frac{1}{4}$ inches gave about 18 candles

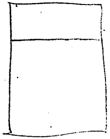
~~68~~

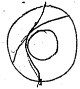
70 candles per sq. in.

An explanation of the changes wh. occur in Pt. may be the following. The Pt absorbs an enormous amount of H gas which is given off at high temperatures

Feby 4 1879

TAE
Chas Batchelor





3 Chalk
9 gr acetate Hg
1/2 fluid oz Caustic Soda

Chalk for Telephones -
New Receiver Feb 24
1878

[illegible] Edison
Chas Batchelor

take 6 oz chalk in mortar and add to it 18 grains of acetate Mercury. grind these up thoroughly then add 1 fluid oz Caustic Saturated Solution Caustic Soda - when all is well ground -

.92 Ohms Feby 26 1879
TAE

---

20 feet .61 Ohms

5 ft to turn

5/.61
.125 Ohm in Turn
25 turns
~~.125~~
625
250
2/3.125

4/.61
.152 Ohms in turn
25
760
304
2/3.800 Ohms
1.900 Ohms

.018 1.9
.018

144
18

.000324
2

6'48' (25
4
4)248

(2500
62

26
26

156
52

676

(20

.025 .024
.028

~~[illegible]~~
120
5

60.5)1250 2.06
1210
4000

6
1

8
3
24
50

8
3

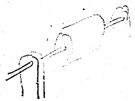
12
12
144 ft
on block

.01	5 ft
.02	10 ft
.02	10 ft
.05	25 ft
.10	50 ft
.20	100 ft
.2	100 ft
.5	250 ft
1.10	

10 lbs of No 15 wire
2 lbs of No 18 wire
1 lb of No 23 wire

.01	5 ft	No. 15	
.02	10 ft		
.02	10 ft		10 lbs
.05	25 ft		
.10	50 ft		
.10	50 ft		
.20	100 ft		
.50	166 ft	No. 18	2 lbs
1.00	No 20		10 lbs
1.00	118.		
2.00	No. 23		1 lbs.
5.00	No 27		1 lb.
10.00	No 30		1 lb.
10.00			2 lbs.
20.00			
[illegible]			

10 lbs No 15
2 lbs No 18
1 lb No 23
1 lb No 27
2 lbs No 30



L.W. Serrell. Feby 26 1879

Mch 5th 1879 TAE

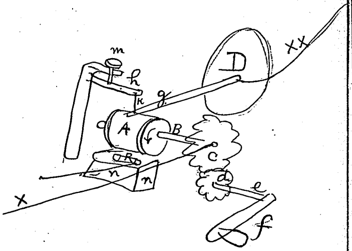
A US. patent is to be taken out on this for W.U. ~~for~~ which I furnish you a model — I also furnish you a second model to go with the Canadian patent —

This is the US. specification

The object of this invention is to transmit and reproduce sounds telephonically at a distance with great power and without loss of volume —

~~The principle of the~~
~~The invention consists~~

The peculiar action upon which ~~advantage~~ this invention is based was patented by me (original Electromotograph patent) & Number ________. An application of this action to telephony was also patented or applied for ________ ([illegible]) This is the patent where a band of paper was used) - The present application consists more particularly in devices which make the invention perfectly practicable for u[illegible] in Commerce and infinitely more reliable & effective


m
h
k
g
D
XX
A
B
C
d
e
f
R
n
n
X

A is a cylinder of ~~chalk~~ Compressed Chalk soaked in an Electrolytic Solution such as ~~a~~ Caustic alkali that it may become a Conductor of Electricity

I will mention that any finely divided non conducting material or porous body having capillary pores & which has no chemical action upon the absorbed solution may be used.

This cylinder is secured to a shaft B ~~[illegible]~~ & the whole is rotated by the operation by means of ~~&~~ the toothed wheels c & d, and shaft & handle e & f ~~[illegible]~~ worm & pinion may be substituted and any ~~[illegible]~~ motor power of a ~~the hand~~ ~~of the [illegible]~~ Clock work or analagous motor made to replace the hand of the operator.

Resting upon the cylinder A is a flat spring g connected to the diaphragm D. this spring is pressed upon the chalk with a pressure of several pounds by means of the wire K & spring h. the screw m serving to increase or decrease the amount of pressure - The line wire xx is connected to the spring g while the Earth wire is connected to the shaft on which the Cylinder A is secured.

If now the cylinder be rotated in the direction shown by the arrow & no Current passes the normal friction of the spring g upon the surface of the Cylinder A will be very great and the spring will be carried forward in the direction of the rotation of the cylinder thus pulling inwardly

4 5/16 - 14.

34.

~~14. 4 5/16 5 ~ c~~

~~69~~

~~34~~

~~276~~

~~207~~

~~(14) 2348~~

~~173~~

~~16 168~~

~~10 1/2~~

The diaphragm D, if now a current passes whose direction is such that Hydrogen will be produced upon the surface of the spring g in contact with the chalk. the friction will be reduced to an extent proportional to the strength of the current ~~and the~~ hence the diaphragm will regain its natural position and continue there as long as the current passes as the friction between the spring g & A is too small to produce sufficient traction [illegible] if now the current ceases the normal friction at once obtains. the traction increases & the diaphragm is instantly pulled outwardly if now a current in the opposite direction is transmitted the effect is when scarcely noticeable as the evolution of

Oxygen upon the surface of the spring g does not except with a ~~pe~~ few ~~th~~ solutions decrease the friction like Hydrogen but on the contrary generally tends to increase the normal friction, hence I allow a constant current to circulate on the line and am thus enabled to ~~use~~ utilize the opposite waves by causing them to weaken the constant

Current which is always in a direction to evolve Hydrogen on the surface of the spring .g.

for instance if no constant Current was upon the line the only ~~one of the~~ waves in one direction waves produce an effect whereas if a constant current is circulating one of the waves adds to that ~~strength~~ of the current

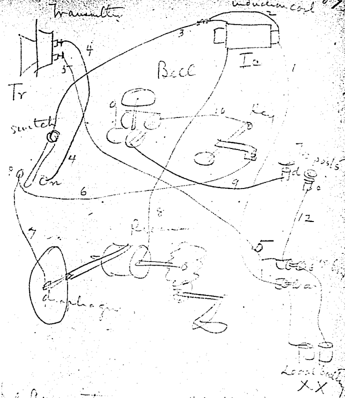
and the other wave
neutralizes or nearly neutralizes
the Constant Current
hence the tendency of
1 wave is to produce a
lessening of friction of
say 5 units which added
to that produced by
the Constant current
say 5 together give
10 units if now an
opposite current is
sent it neutralizes
the Constant Current

& we have the normal friction of the cylinder whereas if no constant current was used one current would lessen the friction by 5 units & the opposite current would perform no work.

N is a receptacle ~~of~~ containing water. resting in the water is a roller R composed of any flexible absorbing substance such as

Sponge or felt,
A lever to which the
roller is attached & by
which the roller may
be brought in Contact
with the cylinder A.
Extend through the box
to the outside, the
object of this device
is to supply the cylinder
with water lost by
Evaporation & make it
a Conductor to the
Electric Current

In practice when all the apparatus is enclosed in a Cast iron case the loss ~~of~~ by evaporation is very small and if the roller be held against the cylinder & if the cylinder be rotated three or four times the chalk will take up sufficient moisture so that it will perform its functions for a week or more without again wetting it =


Transmitter
induction coil
2
3
4
5
Tr
Bell
Ic
1
switch
Key
10
4
On
6
9
posts
7
12
8
7
R
5
diaphragm
Local batty
XX

The Connections are as follows

Tr is the Regular Carbon telephone transmitter placed in a local circuit with one induction Coil I c. with local battery If the position of the switch lever is on the button n. then the current proceeds from the local battery XX via wire 1 thence through the primary coil thence via wire 2 to 3 thence to the switch lever thence via wire 4 through the Carbon transmitter thence by wire 5 to the post 6. thence to the battery The sonorous waves of the Voice are translated into Electric waves of a positive + negative character

in the secondary coil of the
Inductorium I2 in the
well known manner,
The Connections of the main
line is as follows the line
from the distant Station
Enters at the post d.
thence via wire 9 to the
bell thence via wire 10 to
the Key lever thence
via wire 6. to the point
p ~~the~~ of the switch
thence via wire 7 to
the spring 9 of the
receiver thence through

the moist chalk to wire
8, to & through the
secondary coil thence
via wire 3 to the switch
lever which it will be remembered
is on n thence via wire 4
through the commutator to
wire 5 - thence to post
6 & thence via wire 12
to the post c which is
connected to the earth.
I will mention that either
of the posts d o may be
connected to the ground
or line, It will be noticed
that the main line passes
through the commutator

which is connected to the
Local Battery hence a
portion of the current leaks
into the main line & it
is this portion which thus
leaks into the line that
serves as a Constant
Current for short lines
but if the line be to
long or has too great
a resistance this small
leakage current is
so weakened as to be
insufficient to produce
a lessening of friction

between the spring 9 & the
Chalk hence I ~~[illegible]~~ insert 1
or more cells ~~to the~~ in the
main line =
~~[illegible]~~ while the
switch is in this position
⑱ the lever in control with
n transmitting & receiving
can go on simultaneously /
~~If~~ by turning the switch
lever ~~to~~ the point -p.
the ~~telephone~~ apparatus
is disconnected & the
Call Bell apparatus

become operative, the line
enters at the post d
passes through the Bell via
wire 9 thence via 10 to
Key then via 6 to p
thence via lever to wire 3
thence via 2 through the
primary coil & via 1 to
Local Battery through that
to post 6 thence via 12
to post c to earth, by
depressing the Key the
Circuit is opened & closed
& the two local batteries
1 at each end of the

line become operative to ring the bell.

I will mention, that the two receivers herein described & the two transmitters may all be connected in one line & operated without the aid of induction coils but the results are not equal to that from the use of the coil, also that the Receivers will act as transmitters by ~~reason~~ reason of the fact that when the spring J & the Chalk is at rest the resistance of the whole

is generally about 2500
ohms & the resistance is
reduced instantaneously to
2 or 300 ohms by the slightest
movement of either the
chalk or chespring ~~the~~
~~Effect is~~ hence the movement
of the diaphragm D by the
voice produces the same
result or nearly so as the
carbon transmitter, ~~and~~
~~advantage~~ ~~one~~ if advantage
is to be taken of this fact
the surface of ~~all~~ the
spring g (should be reduced)
to increase the Effect
and an induction coil
having a primary coil

of high resistance [illegible]

[illegible]

although [illegible]

necessary [illegible]

[illegible]

2. opening [illegible]

[illegible]

[illegible]

[illegible]

[illegible] power [illegible]

[illegible]

from [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

of the fact [illegible]

normal function of [illegible]
[illegible]
[illegible]
in the check [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible] the [illegible]
[illegible] it [illegible]
[illegible]
[illegible] the [illegible]
[illegible] & it supplies [illegible]
until the [illegible]
[illegible] below a certain

[illegible] —

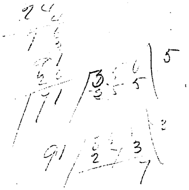
~~[illegible] the use [illegible]~~
~~a cylinder [illegible] or [illegible]~~
~~[illegible]~~
~~[illegible]~~
~~[illegible]~~
~~[illegible]~~

1) Carry the [illegible]
[illegible] of [illegible]
a distance [illegible]
and [illegible]

2) The use of [illegible]
[illegible] compared [illegible]
persons [illegible]

with an Electrolytic solution
with an ~~[illegible]~~ electrode connected
to a diaphragm plate or other
body capable of rendering
the vibrations produced by Electrolysis
~~[illegible]~~ audible —

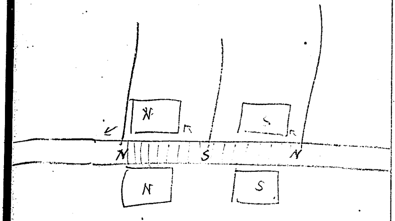
3rd In combination with
such cylinder [illegible] [illegible]
in a closed receptacle [illegible]
of a ~~salt~~ maintaining in the
a equivalent supply of
water such as set forth

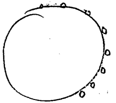


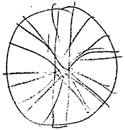
4. ~~[illegible]~~

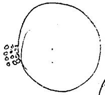
~~[illegible]~~

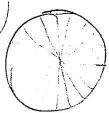
~~[illegible]~~



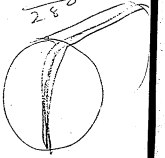


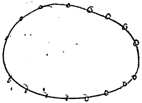


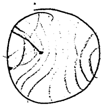


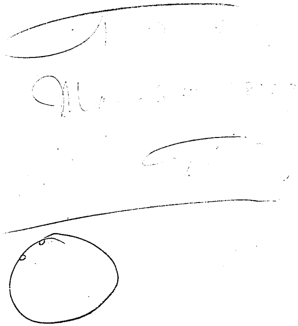


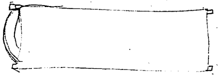
14
20
2.80











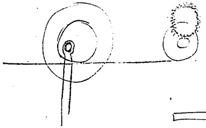
6 – 18·84

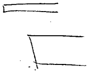
5'

5 turns would equal ·25 top & bottom ·50

12·50 inch

11





3·1416
6
18·8496

·040
·50
40 · 2·000

·049 | 18·800 (391

55 | 18·850 (343

55 | 16·850 (306
165
350

25 | 306 (12
25
56
50

2·04
2·21
204
408
4·5084

232 | 40·0 (0·17
232
1680
1624

6·50
6·50

138 | 1012 (7
966
46

4·25 | 4·5084 (1·06
4·25
2580

·17
12
2·04

·17
13
51
17
2·21

New shell for Order 58

#18 wire in 25 coils

18 wire = ·049 = 232·3 feet per ohm

Shell 6" diam = 18·85 –

~~391 wires~~

18 wire ~~#~~ silk = ·055 = 343 wires in circumf.

18·85 – 2·(·040 for drum) = 16·85

16·85 ÷ ·055 = 306 wires

306 wires ÷ 25 = 12 wires to each coil : 6 on top
and 6 on bottom or 6 whole turns

6 whole turns would be 27 inch × 6 = 162 × 3 layer
= 486 inch = 40·5 feet = ·17 ohms

Resistance of ring $= \dfrac{(12 \times {\cdot}17) \times (13 \times {\cdot}17)}{(12 \times {\cdot}17) + (13 + {\cdot}17)} = \dfrac{2{\cdot}04 \times 2{\cdot}21}{2{\cdot}04 + 2{\cdot}21} =$

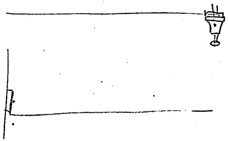
$\dfrac{4{\cdot}5084}{4{\cdot}25}$ = about 1 ohm

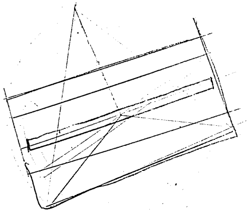
12·56
528
25
37 | 924
Cir ·018
12·56
603 feet = 1½ ohms.
59
8
472
500
·083
576 turns × 12·56 inch
each ·09 = 11 per inch
1·1
501 | 552
432½
·113 | 9
1440
576

Wire for Field Magnets of Order 58

Each 2 ft long = 4 feet long of 4 in diameter
Resist. required 1 ohm
1 layer of No 16 cotn cov. = 7234 inch = 613 feet
= 1½ ohm (will not do)
1 layer of No 15 cotn cov = (11 turns per inch) — 48 inch
× 11 = 528 turns of 12·56 inch each =
528 × 12·56 = 6631 inch = [illegible] feet = 1·1 ohm
2 layers #13 = ($\overset{95}{\cdot 113}$ thick) 9 per inch
48 × 9 = 432 turns × 12·56 inch =
5400 in = 450 feet + next layer 450 feet =
= 900 feet = 1·01 ohm

Order for this (37 feet per lb)
30 lb of No 13 cotn cov.
wire the diameter of the
wire bare must be ·095
95 thousandths

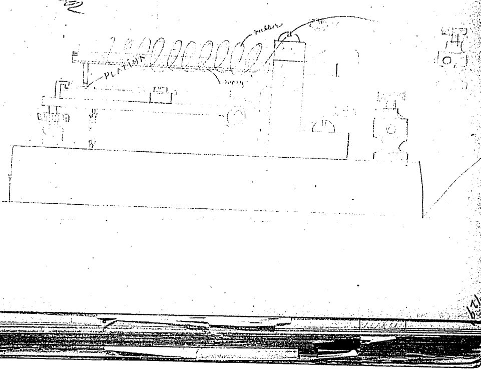




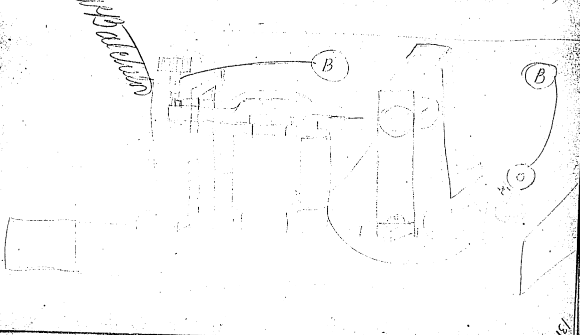
The Long magnets require 643 ft of No 11 = ·120 wire ~~each~~ = 0·461 Ohm = 56 lbs.

No. 100 regulator f. E Light
April ~~4th~~ 79

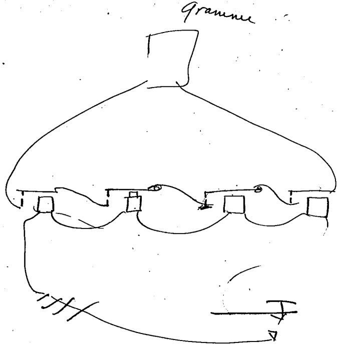
Chas Batchelor


rubber
ivory
PLATINA

No 101 April 14th 79
[illegible]

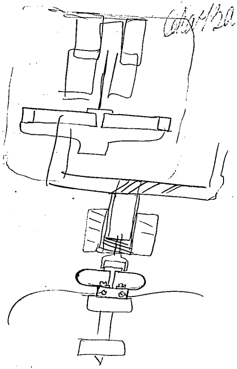


C. W. Batchelor

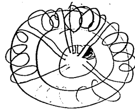


April 4 1879
TAE

April 4 1879
TAE
Chas Batchelor

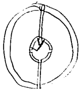


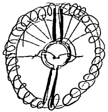
April 4 '879

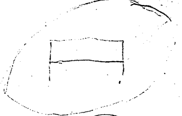


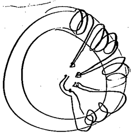
TAE

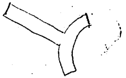
Chas Batchelor











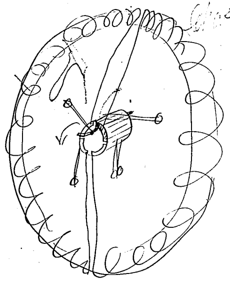
April 4

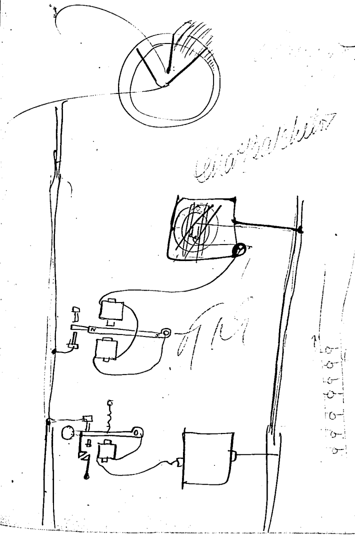
1879 TAE

April 4 1879

T A E

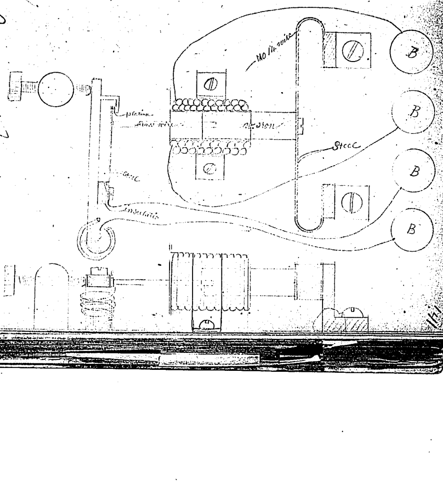
Chas Batchelor




N
S

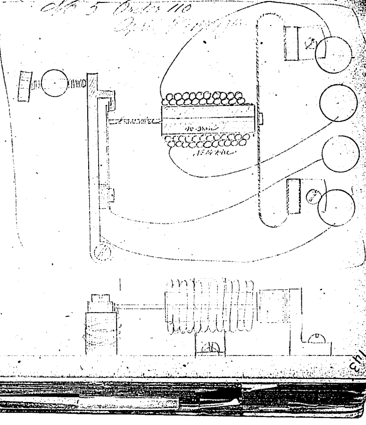
Regulator No 166 B 24 Pg 81
Orders 109 April 7 '79
J.K.

[illegible] point wire
[illegible]
[illegible]

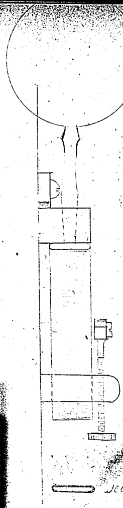

B
B
B
B
No 14 wire
Steel
platina
brass wire
soft iron
Steel
insulated

T A E
Chas Batchelor

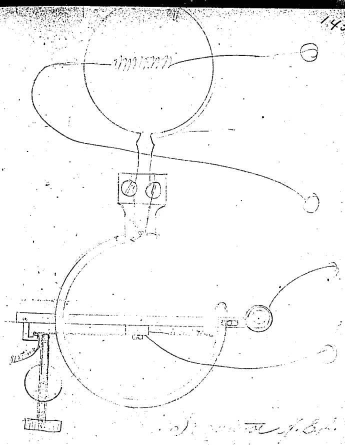
Printed — No 5 Order 110



T A E
Chas Batchelor

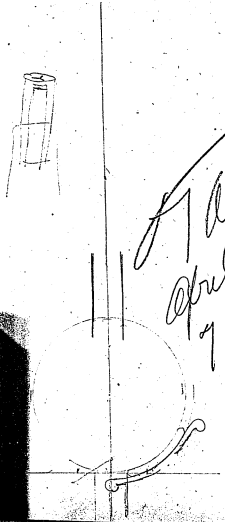

Section of tube

April 7 1879



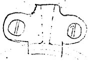
Signature of T.A.E. [illegible]
[illegible]
April 5th 1879
J.K.

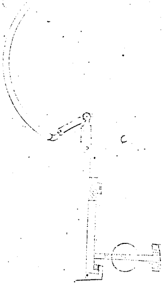
T A E
Chas Batchelor



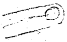
TAE
April
7 1879

Regulator for E.L. April 19/79
[illegible] Caveat 113





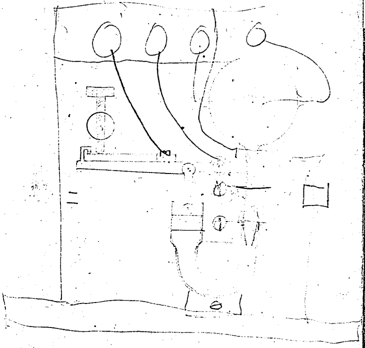
TAE Chas Batchelor



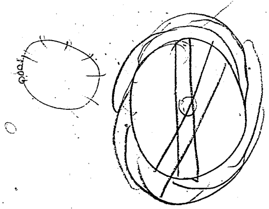
Regulator f. E.L. No 2 Orders No 112

Recd 5th 24.
J.K.

Chas Batchelor

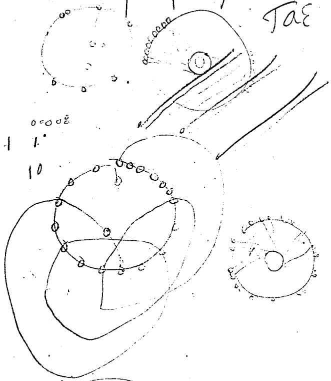


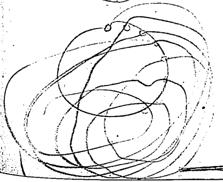
TAE



9 april 7, 1879

TAE





1. Portland

4 sec
3
14:52

60/pe 3 60s = 14'52

HP
1000

250 machines 1 hr

150
50
7500
3750

15

45

```
       750
        45
      3750
    3000
12) 33750 (2812
    24
     97
     96
      15
      12
       30
       2.4
```

2812.

520.

30

Posila

P

P

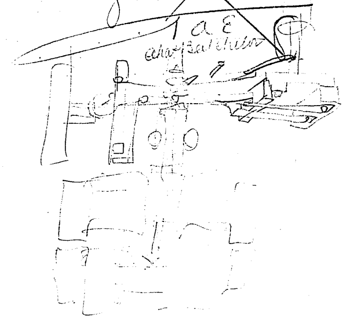
B

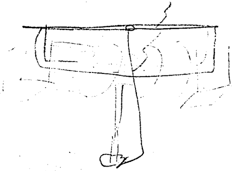
1 — 1·14
2 — 1·11
3 — 1·04
4 — ·96
5 — ·86
6 — ·74
7 — ·61
8 — 45
9 — 41
10 — 41
11 — 41
12 — 45
13 — ·66
14 — 72
15 — 84
16 — 93
17 — 1·02
18 — 1·09
19 — 1·13
20 — 1·17
21 — 1·16
22 — 1·19
23 — 1·16
24 — 1·12

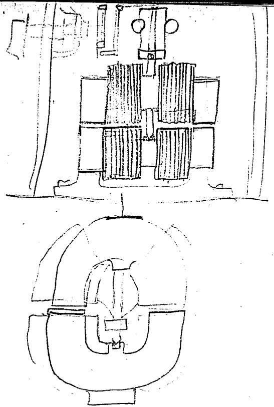
25 — 1·07
26 — [illegible]
27 — 40
28 — 74
29 — [illegible]
30 — 53
31 — 48
32 — 47
33 — 48
34 — 47
35 — [illegible]
36 — [illegible]
37 — [illegible]
38 — [illegible]
39 — [illegible]
40 — [illegible]
41 — 1
42 — [illegible]
43 — [illegible]
44 — [illegible]
45 [illegible]

May 9 1879

TAE
Chas Batchelor





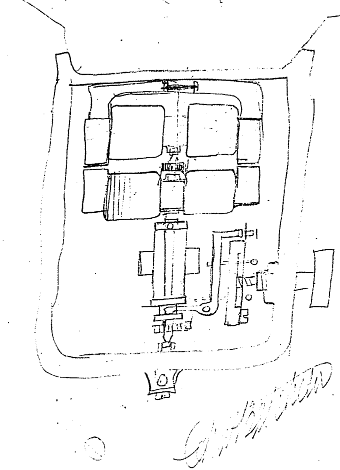


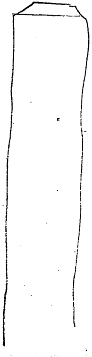
May 9 1879

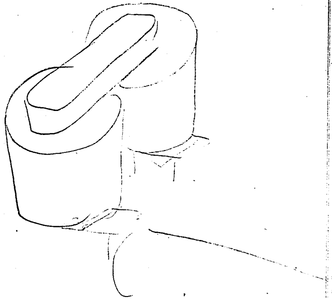
TAE

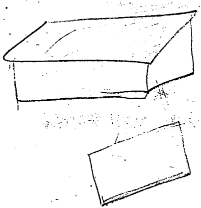
Chas Batchelor

May 9 1919









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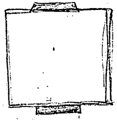


850,

300 | 50000 0

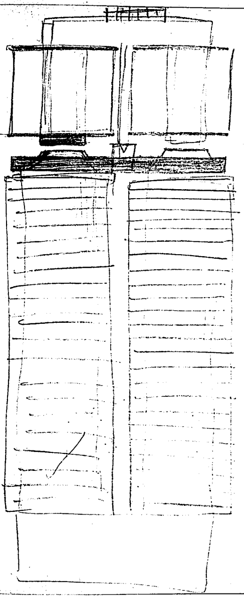
166,666 6

20

25,
6
150

300,

3,333,320



X

Yuma 120
120
~~Buggy~~ 100
||| 480

300 / 1000

51.

30
8

60
8
480 /

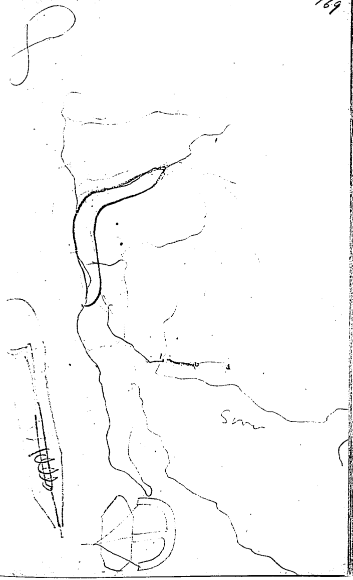
18000

1896

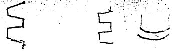
||||||||
8

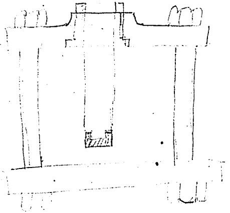
S.F. 180.
Columbus 1.00.
Yuma 1.20
June 1 20
480.

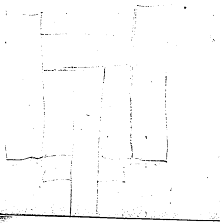
1000..



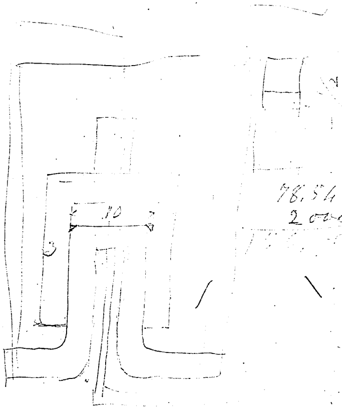
115
2,000
226,000







12 = 113.
2000
226,000



78.54
2000

25

1/2

1	100
2	50
4	25
8	$12\frac{1}{2}$

$12\frac{1}{2}$

25, 50 -

20.000 1[illegible]

1

25.

Dollars	Lights
132 00	110
119 90	110
107 80	110
95 70	110
83 60	110
71 50	110
59.40	
47.30	
35 20	
23 10	
11 00	
786,50	

110 wires

to 340 feet from station

4

5

1100,

83 60
71 50
12,1 0.

132 00
119 90
12.1 0

36

37
18 ÷
5 5

55
25
275
110
1375
2
27.50. 1/4 mile..

10

7

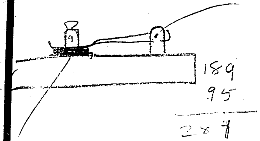
110
10
1100.

176

$\frac{1}{4}$ miles 12 $\frac{1}{2}$ wire, 10 lights each house

1250.	1500	
1240	1490	
1230	1480	
1220	1470	
1210	1460	
1200	1450	
1190	1440	
1180	1430	110 Lights
1170	1420	
1160	1410	
1150	1400,	132,00
13200		
1140	1390	
1130	1380	
1120	1370	
1110	1360	
1100	1350	
1090	1340	110 Lights
1080	1330	
1070	1320	
1060	1310	
1050	1300	
1040	1290	119.90
11990		
1030	1280	
1020	1270	
1010	1260	
10.00	1250	
990	1240	
980	1230	
	1220	
970	1210	
960	1200	107.80
950	1190	
940	1160	
930		
10780	4	

177



189
95
284 — $\frac{1}{4}$ ohm

25
50
125

45
25
225
90
1125

1 cent per foot

5

.10. .10

last man 10 [illegible] Lamps, total R 10 ohm cond. No 12½
40 lbs. at 25c 1250,

780
780
8580

27
127
156, ,20,
5
711

920	1170
910	1160
900	1150
890	1140
880	1130
870	1120
860	1110
850	1100
840	1090
830	1080
820	1070
9570	

9570

810	1060
800	1050
790	1040
780	1030
770	1020
760	1010
750	1000
740	990
730	980
720	970
710	960
8360	

8360

4

700	950
690	940
680	930
670	920
660	910
650	900
640	890
630	880
620	870
610	860
600	850
7150	

7150

4

590	840
580	830
570	820
560	810
550	800
540	790
530	780
520	770
510	760
500	750
490	740
5940	

7150
1210
5940

70

540
to = 2310
440.

80
90
100
110,

5

840
to
740

440
to
340..

2310
1210
1100.

740
to
640 = 4730

5940
1210
4730.

640
to = 3520
540

4730
1210
3520.

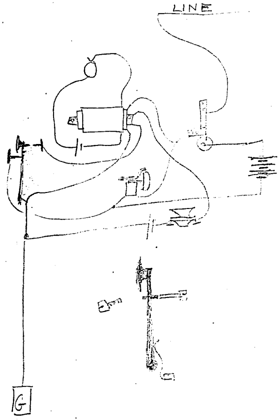
3520
1210
2310

May 17th 1919

George
Take a large piece of coke
instead of Carbon [illegible]
Powder the coke about
size of pin head
Put up about 4 cells this

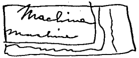
Make a battery of
Zinc and copper
using a solution of $CuSO_4$

~~In this [illegible] $SO_4 + H_2O$~~
~~Put the Zn + C together &~~
~~Pour paraffin~~


LINE
G

~~Gramme Speed of~~
~~[illegible]~~ 1050
~~Second Speed~~

Edison's Dynamo
First 250
Second Speed 856
Third " 520

Edison Dynamo 

Fall in E.M.F.
1 lamp 100 Ohms
Conductor 1 ohm Machine 1/2 Ohm

~~1.5+100~~ ~~$\frac{1.5}{100}$~~

$\frac{1.5}{50}$ $\frac{100}{101.5}$

$\frac{50}{51.5}$ $\frac{25}{26.5}$

$\frac{12.5}{14}$

$\frac{100}{101.5}$

~~2.00[illegible]~~
2.0064
~~[illegible]~~
$\bar{1}.9936$ .985
2
$\bar{1}.9872$ .971
2
$\bar{1}.9744$ .942

2 $\frac{50}{51.5}$

1.6996
1.7118
$\bar{1}.9872$ .971
$\bar{1}.9744$ .943
$\bar{1}.9488$ .889

3 $\frac{~~25~~}{~~26.5~~}$ $\frac{33.33}{34.83}$

1.5228
1.5420
$\bar{1}.9808$ .957
$\bar{1}.9616$ .915
$\bar{1}.9232$ .838

4 $\frac{~~12.5~~}{~~14.0~~}$ $\frac{25}{26.5}$

1.3979
1.4232
$\bar{1}.9747$ .943
$\bar{1}.9494$ .890
$\bar{1}.8988$ .792

5 $\frac{~~6.25~~}{~~7.75~~}$ $\frac{20}{21.5}$

1.3010
1.3324
$\bar{1}.9686$ .930
$\bar{1}.9392$ .869
$\bar{1}.8784$ .756

6 $\frac{16.66+}{18.16+}$

1.2216
1.2588
$\bar{1}.9628$ .918
$\bar{1}.9256$ .843
$\bar{1}.8412$ .694

7 $\frac{14.28}{15.78}$

1.1547
1.1982
~~1.27~~
$\bar{1}.9565$ .905
$\bar{1}.9130$ .818
$\bar{1}.8260$ .670

8 $\frac{12.5}{14.}$

1.0969
1.1461
$\bar{1}.9508$ .893
$\bar{1}.9016$ .797
$\bar{1}.8032$ .635

9 $\frac{11.11}{12.611}$

1.0454
1.1008
$\bar{1}.9446$ .880
$\bar{1}.8892$ .775
$\bar{1}.7784$ .600

10 $\frac{10.}{11.5}$

1.
1.0607
$\bar{1}.9393$ .870
$\bar{1}.8786$ .756
$\bar{1}.7572$ .572

11 ~~[illegible]~~
9.09
10.59

.9586
.0248
$\bar{1}.9338$ .859
$\bar{1}.8676$ .721
$\bar{1}.7352$ .543

12 ~~[illegible]~~
8.333
9.833

.9208
.9927
$\bar{1}.9281$ .847
$\bar{1}.8562$ .718
$\bar{1}.7124$ .516

13 ~~[illegible]~~
7.6923
9.1923

.8861
.9635
$\bar{1}.9226$ .837
$\bar{1}.8452$ .700
$\bar{1}.6904$ .491

14 ~~[illegible]~~
7.14
8.64

.8537
.9365
$\bar{1}.9172$ .826
$\bar{1}.8344$ .683
$\bar{1}.6688$ .466

15 ~~[illegible]~~
6.66
8.16

.8237
.9120
$\bar{1}.9117$ .816
$\bar{1}.8234$ .666
$\bar{1}.6468$ .443

16 ~~[illegible]~~
6.25
7.75

.7959
.8893
$\bar{1}.9066$ .806
$\bar{1}.8132$ .650
$\bar{1}.6264$ .423

17 ~~[illegible]~~
5.8823
7.3823

7696
~~[illegible]~~
.8683
~~[illegible]~~
$\bar{1}.9016$ .797
$\bar{1}.8032$ .636
$\bar{1}.6064$ .404

18 ~~[illegible]~~
5.555
7.055

.7447
.8485
$\bar{1}.8962$ .787
$\bar{1}.7924$ .620
$\bar{1}.5848$ .384

19 ~~[illegible]~~
5.263
6.763

.7213
.8301
$\bar{1}.8912$ .778
$\bar{1}.7824$ .606
$\bar{1}.5648$ .367

20 ~~[illegible]~~
5
6.5

.6990
.8129
$\bar{1}.8891$ .769
$\bar{1}.7722$ .592
$\bar{1}.5444$ .350

25 $\frac{4.}{5,5}$

.6021

.7404

.727 $\bar{1},8617$

.529 $\bar{1},7234$

.280 $\bar{1},4468$

30 $\frac{3.333}{4.833}$

.5228

.6442

.690 $\bar{1},8386$

.476 $\bar{1},6772$

.226 $\bar{1},3544$

$$
\begin{array}{r}
15\overline{)2000}(133 \\
15 \\
\hline
50 \\
45 \\
\hline
50
\end{array}
$$

130

15.4323

$$
\begin{array}{r}
3.3010 \\
1.1884 \\
\hline
2,1126
\end{array}
$$

100 Ohm lamp 1 ohm conductor & machine

$\frac{100}{101}$ 2,
2,0043
.990 $\bar{1}.9957$
.982 .980. $\bar{1},9914$
.961 $\bar{1},9828$

2 $\frac{50}{51}$ 1,6990
1.7076
.980 $\bar{1},9914$
.961 ,961 $\bar{1},9828$
.924 $\bar{1},9656$

3 $\frac{33.33}{34.33}$ 1,5228
1,5357
.971 $\bar{1},9871$
.941 .942 $\bar{1},9742$
.886 $\bar{1},9484$

4 $\frac{25}{26}$ 1,3979
1.4150
,961 $\bar{1},9829$
.924 .924 $\bar{1}.9658$
.854 $\bar{1},9316$

5 $\frac{20}{21}$ 1,3010
1,3222
~~[illegible]~~
.952 $\bar{1},9788$
.907 .907 $\bar{1},9576$
.823 $\bar{1},9152$

6 $\frac{16,66}{17,66}$ 1,2216
~~[illegible]~~
1.2471
~~.9076~~
.943 $\bar{1},9745$
,889 $\bar{1},9490$
.791 $\bar{1},8980$

7 $\frac{14.28}{15.28}$

1.1547

1.1831

.937 $\bar{1}.9716$

.877 $\bar{1}.9432$

.770 $\bar{1}.8864$

8 $\frac{12.5}{13.5}$

1.0969

1.1303

.926 $\bar{1}.9666$

.857 .857 $\bar{1}.9332$

.735 $\bar{1}.8664$

9 $\frac{11.11}{12.11}$

1.0454

1.0832

.917 $\bar{1}.9622$

.840 $\bar{1}.9244$

.706 $\bar{1}.8488$

10 $\frac{10}{11}$

1.

1.0414

.909 $\bar{1}.9586$

.826 .830. $\bar{1}.9192$

.689 $\bar{1}.8384$

11 $\frac{9.09}{10.09}$

0.9586

1.0641

.901 $\bar{1}.9545$

.811 $\bar{1}.9090$

.653 $\bar{1}.8160$

12 83333

~~58823~~

~~8.6823~~

9.3333

$.9208$

$.9702$

.890 $\bar{1}.9496$

.795 .793 $\bar{1}.8992$

.629 $\bar{1}.7984$

13 $\frac{7.6923}{8.6923}$

$.8861$

$.9392$

$.885 \quad \bar{1}.9469$

$.783 \quad \bar{1}.8938$

$.613 \quad \bar{1}.7876$

14 $\frac{7.14}{8.14}$

$.8537$

$.9106$

$.877 \quad \bar{1}.9431$

$.769 \quad \bar{1}.8862$

$.592 \quad \bar{1}.7724$

15 $\frac{6.66}{7.66}$

$.8237$

$.8842$

$.870 \quad \bar{1}.9395$

$.757 \quad \bar{1}.8790$

$.573 \quad \bar{1}.7580$

16 $\frac{6.25}{7.25}$

$.7459$

$.8603$

$.862 \quad \bar{1}.9356$

$.743 \quad .743 \quad \bar{1}.8712$

$.552 \quad \bar{1}.7424$

17 $\frac{5.8823}{6.8823}$

$.7696$

$.8377$

$.855 \quad \bar{1}.9319$

$.731 \quad \bar{1}.8638$

$.534 \quad \bar{1}.7276$

18 $\frac{5.555}{6.555}$

$.7447$

8165

$.848 \quad \bar{1}.9282$

$.718 \quad \bar{1}.8564$

$.516 \quad \bar{1}.7128$

19 $\frac{5.263}{6.263}$ .7213

.7968

.840 $\bar{1}.9245$

.706 $\bar{1}.8490$

.499 $\bar{1}.6980$

20 $\frac{5.}{6.}$ .6990

.7782

.833 $\bar{1}.9208$

.694 .694 $\bar{1}.8416$

.482 $\bar{1}.6832$

25 $\frac{4}{5}$ .6021

.6990

.800 $\bar{1}.9031$

.640 .640 $\bar{1}.8062$

.410 $\bar{1}.6124$

30 $\frac{3.333}{4.333}$ .5228

.6368

.769 $\bar{1}.8866$

.575 .592 $\bar{1}.7720$

.350 $\bar{1}.5440$

$592 \times 2 = 1184$

592

$\mathcal{W} = \frac{\varepsilon^2}{R}$ $R = r + \frac{l}{n}$

Work in lamp =

$$\varepsilon_l = \frac{\varepsilon \frac{l}{n}}{r + \frac{l}{n}}$$

$$W_l = \frac{\varepsilon^2 \frac{l^2}{n^2} \cancel{\frac{l}{n}}}{(r + \frac{l}{n})^2 \times \frac{l}{n}} = \frac{\varepsilon^2 \frac{l}{n}}{r + \frac{l}{n}} \therefore$$

$$\frac{\varepsilon^2 \left(\frac{l}{n}\right)^2}{\left(r + \frac{l}{n}\right)^2} \frac{1}{l} \qquad W \frac{\varepsilon^2 \left(\frac{l}{n}\right)^2}{\left(r + \frac{l}{n}\right)^2} \frac{1}{l}$$

965 3.9845

903,5 3.9557

1.0288

1.06

1.775 1.2492

8225 .9157

.3341

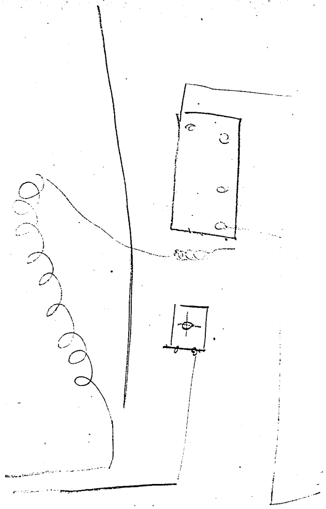
2.16 Ohms

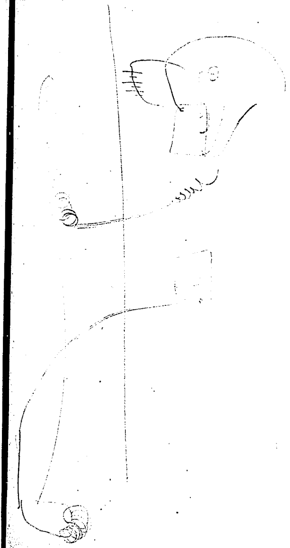
2455 .3901

7545 .8660

.5241

334





Portland

Portland

Portland

Portland

Portland

Portland

Portland

Jan'y. Gal.	J. R. G.
52½	70 L
[illegible]	190 L
22	178 L
58	2?4
50	

Solarium

Photinum

Cherokee

Litenium

Machinium

Pelosium

Dynamium

16,

Protenium

Dinamium

Machine

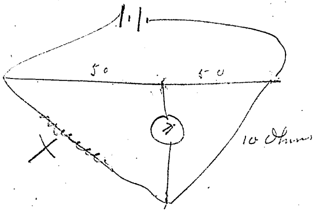
R 12

Machine 6 Plorium

Machine 1 8 84.

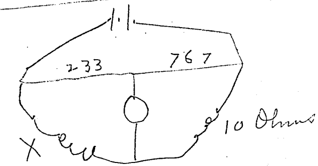
19

81 per machine


50
50
X
10 Ohms

50 : 50 :: 10 : X

$$X = \frac{500}{50} = 10$$

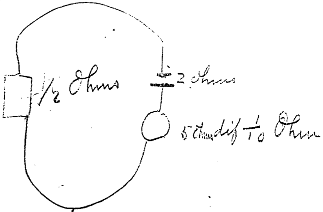

233
767
X
10 Ohms

767 : 233 :: 10 : X

$$X = \frac{2330}{767}$$

$\frac{1}{7.5} \div \frac{1}{10} = \frac{1}{75}$

$\frac{1}{15} \times \frac{1}{75} = \frac{1}{1075}$

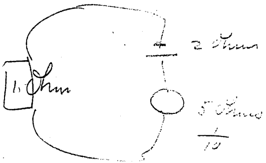

1/2 Ohms
2 Ohms
5 Ohm dif 1/10 Ohm

$\frac{1}{7.5}$ $\frac{1}{75}$ dif in Current

$\frac{1}{15}$ current in coil

$\frac{1}{1.5} \times \frac{1}{75}$ $\frac{1}{1075}$

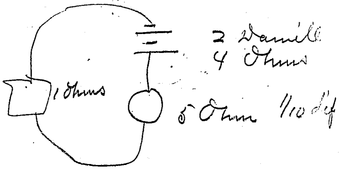
$$\begin{array}{r} 15 \\ 325 \\ \underline{75} \\ 1075 \end{array}$$


1 Ohm
2 Ohms
5 Ohms
$\frac{1}{10}$

.8

$\frac{1}{80}$

$$\frac{1}{8} \times \frac{1}{80} = \frac{1}{640}$$

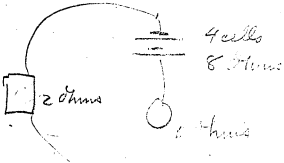

2 Daniell
4 Ohms
1 Ohms
5 Ohm 1/10 def

10 Ohms total

$\frac{1}{100}$

$\frac{2}{10} \neq \frac{1}{5}$

$\frac{1}{500}$


4 cells
8 Ohms
2 Ohms
[illegible] Ohms

$\frac{1}{15}$ $\frac{1}{150}$

$\frac{4\times2}{15} = \frac{8}{15}$

150

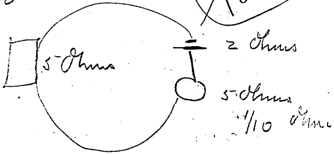
280

8)[illegible] 281

$\frac{1}{281}$

5 Ohms

7 Ohms



12 Ohms Total

$\frac{1}{120}$

$\frac{5}{12} \times \frac{1}{120} = \frac{5}{1440}$

~~$\frac{1}{140}$~~ $= \frac{1}{248}$

~~$\frac{4}{11} \times \frac{1}{10} = \frac{1}{1210}$~~

~~For~~

$\frac{5}{10}$

---

4 Ohms

$\frac{1}{110}$

$\frac{4}{110} \times \frac{1}{110} = \frac{4}{12\,1\text{[illegible]}} = \frac{1}{302}$

~~10 Ohms~~ :

6 Ohms

[illegible] $\frac{[illegible]}{13}$ $\frac{1}{13}$

$\frac{6}{13} \times \frac{1}{130}$

1 $\cancel{\frac{1}{13}}$ $\frac{1}{80}$

$\frac{1}{8}$ = Current

$\frac{1}{64}$ of Elec in Coil

$\frac{1}{64} \times \frac{1}{80}$ $\frac{1}{5120}$

$$\begin{array}{r} 80 \\ \hline 5120 \end{array}$$

---

2 Ohms

$\frac{7}{2}$
9 $\frac{1}{90}$

$\frac{2}{81} \times \frac{1}{90} = \frac{2}{[illegible]} = \frac{1}{3645}$

$$\begin{array}{r} 90 \\ \hline 7290 \end{array}$$

---

3 Ohms 10 $\frac{1}{100}$

$\cancel{\frac{1}{81}} \times \frac{3}{100} \times \frac{1}{1000} = \frac{5}{[illegible]}$

$\frac{3}{10000}$ $\frac{1}{3333}$

4 Ohms. $\frac{7}{\frac{4}{110}}$

$\frac{4}{121} \times \frac{1}{110}$ $\frac{1}{3326}$

$$\begin{array}{r} 11 \\ \cancel{4} \\ 121 \\ 110 \\ \hline 1210 \\ 121 \\ \hline 4)\,13310 \\ \hline 3326 \end{array}$$

---

5 Ohms $\frac{1}{120}$ $\frac{7}{\frac{5}{12}}$

$\frac{5}{}$ $\frac{1}{3456}$

$$\begin{array}{r} \cancel{7}144 \\ 120 \\ \hline 2880 \\ 144 \\ \hline 5)\,17280 \\ \hline 3456 \end{array}$$

6 Ohms

7
6
13
13
39
13
169

$\frac{1}{130}$

$\frac{6}{169} \times \frac{1}{130}$

130
5070
169
6)21970
3661

$\frac{1}{3661}$

$\frac{1}{2}$ Ohm

$\frac{1}{75}$

7.5
7.5
375
525
56.25
2
112.5
75
5625
7875
8437.5

$\frac{1}{\cancel{75}} \times \frac{1}{7.5} \times \frac{1}{75}$

one ohm

1 ohm 500:500::1:? = 1

2 ohm 333:667::1:? = 2 $\frac{1}{333}$

3 ohm 249:751::1:? = 3 $\frac{1}{62}$

4 ohm 19~~8~~5 : 801.5::1:? 4 [illegible]

5 ohm 164:836::1:? = 5 $\frac{1}{21}$

6 ohm

333)667(2
666
1

198.5)801.5(4
794
7.5

249)751(3
747
4

$\frac{4}{249}$ $\frac{1}{62}$

164)836(5
820

$\frac{2}{21}$

748:252::1:?

249)4000(
249
1510

2)748

2)252 126
748 374 187

141)7000(.05
594
1060

21)200(.095

2)40 20
332 166

$\frac{12}{100}$

676)324(64.8 6370

2604

636

5 Ohms Total

399.5)600.50(15
399.5
20100
1997
0125
44

716.5)28350(4
28660

139.5)560.5(6
537.0

139.5)23500(
1395
9550

716
2864 2

399.5)12500(.03
7990
4510
45100

716)2840(3
2148
692

139)46 7

399.5)12500(.03
11985
515

716)2840(4
2864
24

716)6920(.9
5012

716)69200(.9662
6444
4760
4296
4640
4296
3440

717)2838(4
2868

Z

one ohm constant

1 500:500::1:? = 1 ohm

2 333:667::1:? = 2.003

3 249:751::1:? 3.016

4 198.5:801.5::1:? 4.037

5 164:836::1:? 5.[illegible]

6 139.5:860.5::1:? 6.[illegible]

Ten ohm con[illegible]

4 716:284::10:? = 3.96

10 500:500::10:? = 10

15 399.5:600::10:? = 15.03

20 332:668::10:? = 20.[illegible]

25 284:716::10:? = 25.21

1 911.5:89.5::10:? = .981

2 ~~83~~ 836:164 1.96

3 772:228[illegible] 2.95

284) 7160 (25 4
568
1480
1420
284) 6000 (.214
568
320

4

911.5) 89.5 00 (.981 ÷
82 0 35
7 4 6 5 0
7 2 9 2 0
1 7 3 0 0
9 1 1.5

7) 100
1 4 2
2 8 5 6
7 1 4 4

836) 1640 (2

3

836) 1640 (1.96
836
8040
7524
5180
5016
144

2
772) 2280 (2.95
1544
7360
6948
4120
3860

716) 2840 (3
2148
3 2
1000
697) 3030 (4
2788
~~393~~
2

70) 3000 (4
280
220

716) 2840 (3.96
2148
6920
6444
4760

714.4)
244
756
244

176
924

95
915

3,3[illegible]
2.8[illegible]
.5[illegible] [illegible]

.3296 2.[illegible]
[illegible]

974 : 26 :: 10 : ?

26
10
260

4 2

260
974) 260000 (.26
1948
6520
5844
6760
42

18

52

2 | 26/100 | 13/50

2832 4

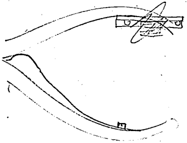
3~~.75~~

2920
2124
796

708 : 292 :: 10 : ?

708) 2920 (3

703) 2970 (4
2812



Same story Electric Light

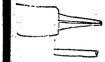
Sept 11 1879.

Chas Batchelor

Edison Laboratory Note Book No. 16.

Pages 227 & 228.

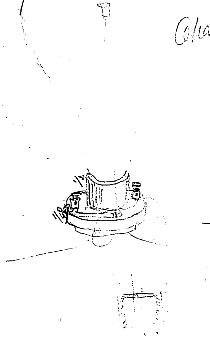
See Edison Patents:
214,636
214,637
218,866
227,227
227,228
227,229

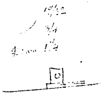


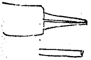
Sept 11 1879.

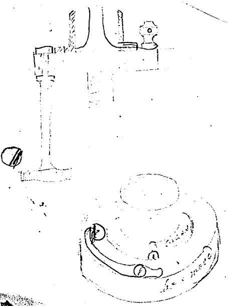
Lamp stand
Electric Light

Chas Batchelor




15/32
3/4
diam 1 1/4





Telephone parts

1 Wooden base
2 " box
3 " boxcover
4 Rubber Receiver box
5 " " cover
6 " " back.
7 Receiver bridge
8 " Palladium Spring
9 " " " nut
10 " " washer
11 " " washer connection
12 Receiver adjusting screw 7d.
13 " " " pin
14 " " rubber
15 " Brass chalk barrel
16 " " " washer
17 " " " nut
18 " Mica diaphragm 18d. pr 20½d
19 " Connection strip [o o]
20 " Shafts

21 Arm
22 Shaft guard
23 Worm wheel and shaft
24 Moveable bearing
25 Worm bracket
26 Worm,
27 handle (Brass
28 handle (composition)
29 Worm guard (dirt)
30 Arm bracket
31 Arm joint washer
32 Shaft sleeve
33 Bracket pin
34 paper washer in joint
35 Coil spool
36 Coil winding
37 Bell
38 6 Bindposts
39 2 Keys with backpoints
40 2 front point points
41 2 Brackets with backpoints
42 2 Key buttons

43 hinge springs (2)
44 2 connections for cover
45 Transmitter base.
46 " cover
47 Boxwood ring
48 " " connec. strip
49 Bottom platina screw
50 Glass disc
51 top platina disc
52 Diaphragm with bush
53 Diaphragm Screw
54 Rubber bush
55 60 Screws
56. 1 Joint Screw
57. Rubber tube for Receiver connection
58 . ft connection wire
59 10 Copper washers
60 Coil core
61 Bushings for Receiver 17¾ & c Comp. 18 ~~17~~

Transmitter	$ 1·35
Bell.	1·05
Receiver	3·25
Balance Box, coil, etc.	4·00
	9·65
	1·25
	10·90
	~~1·25~~
	$12·15

We furnish Chalk roller and palladium

1215
28
12.43

Shipping
Packing to be 28 cts per ~~telephone~~.

Then $12·50 or 9
20
12·70
Then $13·00

Transmitter Oct 1st 79.

1 To turne drill & tap both castings the faces of both must be perfectly true. The Diameter of free Diaphragme to be 2 1/4 inch exact.
Casting must be smoothed on bottom to lay flat on box, depth must be same as our first once.

2. To make boxwood ring

3. " " & platinize & Trace screw which will be furnished in the rough f. our machine

4. " " " " the Top plate &
" ~~for~~ make & put in glass dish

5 " make Conection plate & Conections

6 " Assamble after Japaning
Diaphragme with screw & bush laquer " if not Japanned on both sides.

7 rubber bush
To pollish & blue the screws & laquer them

8 To put it on the box for 75¢.

Receiver

1 To make the chalk rollers complete the screws washers & nuts are furnished as blanc paintings rollers to be turned to size exact, platinized drilled & taped & barrel japanned

Extra rollers for 25¢.

---

2. The Diaphragme to be cut & drilled & put in case

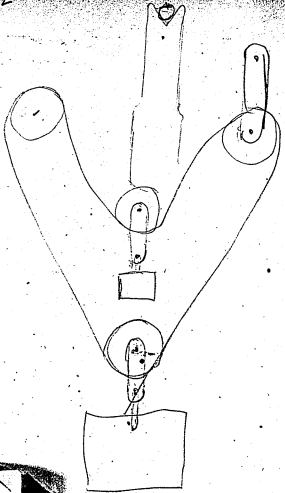
3. To make the spring complete, to size exact, the Palladium to be put on so that it does not need any filing not to be wetted with any fluid, highly pollished without emery, finished straight & exact to size.

4. To make conections with #3 No 35 wires

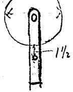
5 To make the rubber piece to size & shape same as model

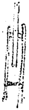
6 To put spring on Diaphrame & set it correct.

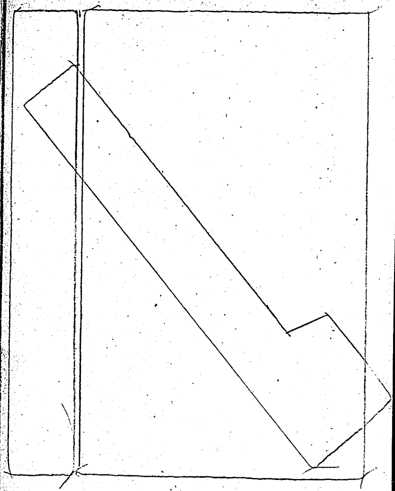
for 60 ¢ sixty



Two 5 inch wheels grooved the same as on small sewing machine wheels







Sizes of Packing boxes for Telephone

Oct 21st 79

small

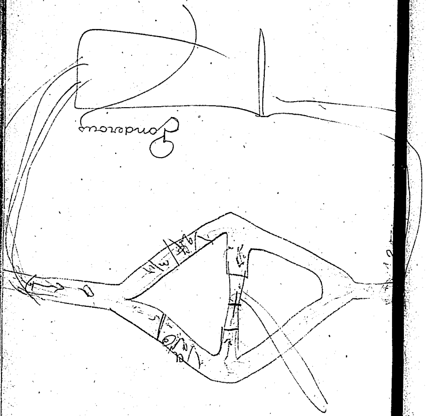
6½ × 12 × 8 Deep.

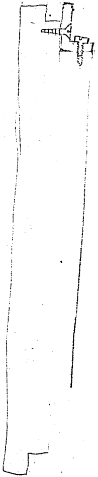
large

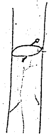
17 × 55½ × 12½ Deep.

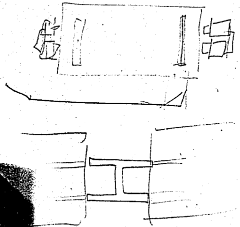
all inside measure.

13 Drei
3
---
16 〃


Ponderous







$\frac{1}{4}$ Mile 8" Water pipe
Cast Iron and laying
$2500 rough.

pipe 1675 00
450 00
laying $2125.00

1200 HP
Condensing Eng. allows
~~investment~~ saving [illegible]
Non Condension [illegible] System
in $50 000 in Coal alone

$7600 less invested in
Boilers

$\frac{1}{3}$ less water for Boilers

$\frac{1}{3}$ less room for Boiler

$\frac{1}{3}$ less depreciation on boilers

Saving in firemen $1460 per year

Saving in rent

Per Contra

Extra Cost of Cond. Eng. over Non Cond. $8160.00

Depreciation ditto

Cost of piping, well etc
for Condensing water (wanted)

Saving in boiler water
by using ^save^ condensing water
over and over $\frac{2}{3}$ (Surface Condenser)

For 1200 H P boilers we should
want 8000 feet of Condensing
surface

The Copper pipe ^to the^ $\frac{1}{32}$ thick $\frac{5}{8}$ hole
takes 32000 feet long + 1280 ft
for ends = 33280 ft
= 12380 lbs at 38¢
= $4704.41

Cost of Condensing Engine per hour per H.P. at 2½ lb

~~Coal ·718 ¢~~
~~Water ·05~~
~~·768~~

Coal	·31
labour	·13
Oil Waste	·016
Rent	·11
labour doubled by	·13
	·022
Water	·05
Interest	·17
Depreciation	·01
	·948 Cts

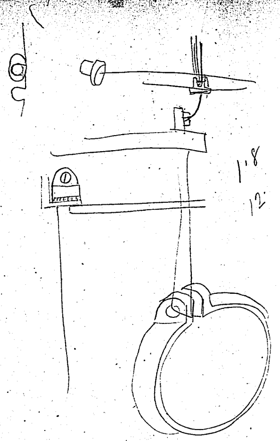
Cylinder 14 X 24

14
14 square diameter
56
14
196

$\frac{1}{6}$ stroke average pressure 31 lbs.

Pressure 6076 lb piston speed
500 ft per min = 72 H.P.

4 Cylinder = 288 H.P.

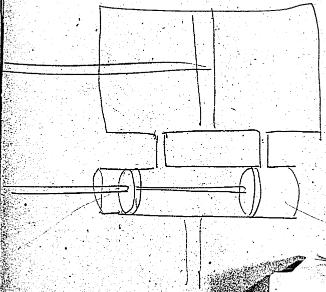


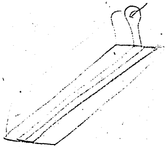
Cylinder 14X24 Contains 3696 □ inch. 3696X2 = 7392. then 7392 ÷ 1728 = 4.27 cu ft of steam at 1.8 atmospheres. 4.27 X 1.8 = 7.28 Cu ft. at pressure atmosphere for each revolution. Then 7.28 X 125 = 910 cu ft per minute

910 ÷ 28 = 32.5 lbs water per min. 32.5 ÷ 10 = 3.25 lbs coal per min — 3.25 X 60 = 195 lbs coal per hour

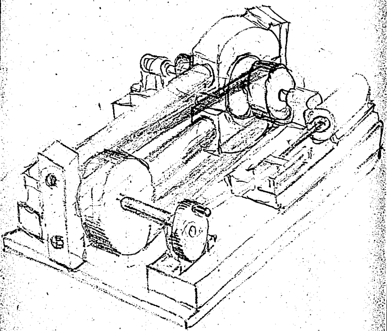
195 X 4 = 780 lbs per hour

250 HP at 3.25 = 812 lbs of. Coal per hour





March 3rd 1880



One Station 1250 H.P. 180 Dynamo
5 – 250 H.P. Engines – to design of Jan 15th 1880

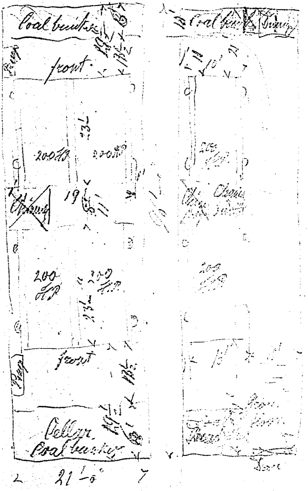
Belts –	$ ✓ 7000
Shafts hangers & pulleys	✓ 5500
Iron Structure –	8.000
Woodflooring –	✓ 3.700
5 Engines	42.500
5 Engine foundations	2.300
180 Faradic Machines	36.000
Boilers 1250 HP	23.000
	128.000
Heaters & Pumps –	7 000
Steampipes	
Chimneys –	1 000
Building &c.	

Space
21 ft width
95 – length
33 – above ground
15' – below –
4' foundation

1250 H.P.
3 lbs Coal per H.P. per hour for 10 hours
37500 = 17. tons average per day
100 tons at 35 cub ft = 3500 cub ft
should be stored in bunkers. —
make 6 bunkers 8 ft wide 6 ft. deep
8' × 8' = 64 sq ft Chimney — 54 to 60 sq. ft area
11 ft. square outside. —
7" diam (40 sq.") Steampipe for each 250 Eng.
6½" " (32 ") " " " 200 H.P. Boiler
15½" " " " Total 1250 H.P. Boil.

30 lbs Water per hour per horsepower
assumed standard.
1250 H.P.
30 lbs water for 10 hours
375.000 lbs Water consumed per day.
46.900 gallons
Pump capacity 4700 gall. per hour.
place 2 Pumps for 400 H.P. 1600 gall each No 7
and 2 " " 200 " " 800 " " No 5

B & W. Boiler Plant. —



Coal bunker
Pump
front
200 H.P.
200 H.P.
19
Chimney
200 H.P.
200 H.P.
front
Pump
Cellar Coal bunker
21'-0"
Coal bunker
Chimney
200 H.P.
Chimney
200 H.P.

12" I beams 3 ft c to c
15000 lbs load on single Beam
30000 lbs Load on Double Beam. —

Boilers for Holly Water Works [illegible]
made there

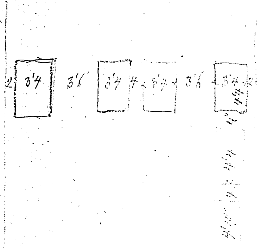
80 H.P. 66" diam 15 ft long 69-4" tubes
32" x 42" dome — (then $912.00). —

7" diam. (40 Sq ins) Steampipe for each 250 H.P.
Engine —
6½" " (32 sq. ins) " " " 200 H.P.
6 x 32 = 192 = 15½ ins. diam. for all 5 Engines

380 Plant. of B.&W. but 9 instead of
8 rows of tubes, add 6" to hight. —
Plan for Blast from other Plant. —

Chimney 8 ft. sq. in clear. —
14 ft. sq. outside
18'-11" outside of Brickbench —
88" each bat. 17" width of Walls.
6"x4½" wide buckstay at middle.
9"x6" wide Endposts
36" diam of drums — about 18' long. —

Smoke flues each 36"x30" —



21" pitt. below floor
9'-11" hights of brickwall at [illegible] end
11' — to centre line of Drum & Water line
13' — to top of columns & bottom of the
12" supporting beams.
18'-5 — centre to centre of bearing supp
29" front of Wall to centre of 1st front support
15" front wall — 7' grate — 23" bridge —
7' to Mud drum support — 12" support.
3'-2 to end wall — 12" end wall. —
42" c. to c. of Steam Drums —

270

Machineshop extension – Bill of Timber

25 Floorbeams 3"x16"–22' long ~~white~~ pine
23 Roofbeams – 2"x12"–24' – "
2 Sills — 4"x16"–23' – yellow pine
4 — — " –27' – " "
1 " – 4"x12" = 27' – " "
4 Stringers – 6"x6"–26' – " "
5 Trusses – 8"x12"–23' – " "
10 " 8"x8"–12' – " "
6 Posts – 10"x12"–15'-6" " "
5 " – " – 12'-6 " "
9 Braces – 4"x8"–6' – " "
4 " – 4"x6"–4' – " "
10 Uprights – 4"x6"–12' — wh pine
2 — 2x6 – 12' —
2 — 4x6 – 15 —
2 — " – 14'-6" —
4 — " – 13' —
2 — " – 13 —
2 — 2½"x6" – 13' —
4 — " – 14' —
6 — " – 15' —
6 — " – 15'-6"
8 — 2"x6" – 4'-0"

$123.

271

Flooring {600 sq. ft. of 1" ~~spruce~~ hemlock
{600 " " " 1½" pine
Roofbords 700 " " " 1" Good spruce
Roofing–700 sq. ×
Siding–for ~~1000~~ 700 sq. ft.
Trimming 12" wide – 500 ft. [illegible]
5 Windows – [illegible] opening
2 Doors – 3'-[illegible] 6.16 [illegible]
4 Corner [illegible] long
2 [illegible] long

10 loads Bonham Sand
16 Barrels Cement

Brick foundation [illegible]
70 ft. × 1⅓' × [illegible] = [illegible]
60 ft. × 1' × [illegible] = [illegible]

8500 bricks

9000 bricks

[illegible]

883
22
700
46
826

Machine shop extension —

26'9" — 3½" Shafting with 5 Hangers 20"

26'9" — 2½" " " 5 " 20"

20 Pulleys — 6" face 32" diam.

1 Pulley — 26" " 36" "

1 " — 14" " 36" "

1 " — 26" " 60" " for 3½" Engine

1 Shaft 3½" — for Exchange

2 or 3 Hangers 3½" — 30" drop

Belts.

20 — 5" — ~~[illegible]~~ 15' long — 15 — 27 — 18

1 — 12" — ~~[illegible]~~ 27' — 15

1 — 24" — ~~[illegible]~~ = ~~44~~' — 12

1 — 24 — — 27' —

Total Estimate

Wood Brick Shafting Pulley $2800 —

Caloric Experiment. – 8" area = 50.265

area × 6¼" stroke = 314 cub. in
per stroke = 1 revol. –
outer piston 3½" stroke

~~16 × 23¼ = 376~~
~~2 × 23¼ = 46½~~
~~8 × 24¾ = 198~~
~~620 inch long pipe × circumference.~~

~~Ericson Engine Fireplace.~~
~~Pott 7¾" diam = 24.34 × 10 = 243.4 sq. inch~~
~~+ 7¾" area = 47.1~~
~~290 5/10 sq. inch heating surf~~
~~or 8" diam = 25.13 × 10 = 251.3~~
~~8" area = 50.265~~
~~301.5/10 sq. inch heating surf~~

~~continued from above~~
~~5/8" circumference – 1.963 × 620½ = 1218. sq. inch heating surface~~

That is 7 times the surface for heating and everywhere at 212 degree. – compared with Ericksons Stove heating. –

Air and all other Elastic Fluids have same expansion, that is 1/480 = .002087 times of their bulk for every degree of heat. – (Specific gravity compared with water = .0012046) that is they expand from 32° to 212° – from 1000 to 1376

~~8" area = 50.265" × 3½" = 176 cubic inch air ~~[illegible]~~ per stroke~~

By equal pressure Steam has 3.136 times the specific heat of Air – and at equal volume 1.960 times

---

20 Volumes of Water absorb 1 volume of air.

Anthracite one lb. requires 195.45 cub. ft. air
Bituminous " " " 150.35 " " "
Coke – " " 108 " "
Wood about 90 " "

1250 H. P. × 3.4 = 3700 lbs. per hour.
or about 63 lbs. per min. require
63 × 200 c. ft. air = 12600 cubic ft air per min. –
No 10 Sturtevant Blower = 14000 c. ft. air per min.
= $ 250.00 · 600 revol. per min. 60" diam. of Fan
14" diam of pulley – 12" face 72" height of Blower
24" diam of inlet – 18" × 24" square of outlet.
9.76 Horsepower.

10 H. P. Vertical Engine [illegible] diam. cyl.
8" stroke. 36" diam of Flywheel [illegible] face
300 lb. weight 200 revol. per min. 29 × 32 [illegible]
room. 69½" high – 1000 lb. [illegible] weight [illegible] 315.00

1 lb. of Coal requires [illegible]
~~or~~ 1250 [illegible] = [illegible] per min.
25 to 30 lbs of Water per hour [illegible]

Locomotive Boiler 12 to 16 [illegible] heating surface [illegible]

Caloric — continued

7 7/8 area = 48.7 × 11½" stroke = 560
+ 2½" " fal= 5" × ¾" = ——— = 3¾
8 area = 50.265 } − 11.78 × 5/8 = = 7¼
− 7 area = 38.484 }
6" area = (28.27 × .75) − .78 = = 20½
content in Chamber = 590 cub inch

Pipes. —
16 × 21¾" long. − 348." }
8 × 23" long = 184" } = 574 ins. length of pipe
4 × 10½" long. = 42" }
5/8" outside diam of pipe = .3067 sq" × 574" = 176 cub inch
9/16" inside diam " " = displaced by pipe —

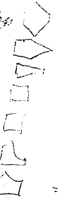
590 −
−176
414 cb ins. content for air in Chamber

314 cb. ins content displaced in Cyl. per stroke

5/8 circum = 1.963" × 574" length of pipe = 1126¾ sq inch
heating surface of pipes =

Ericsons heating Pott offers 290 square inch inside surface to the air or about ¼ of adopted pipe surface. —

8" area = 50.265 20.092 Ericsson Caloric —
7¾" " = 47.173 12 displacement 40 cub ins
¼ 47.173 2.092
12



8 Wood fillings = 60 cub ins.
16 " = 85 " "
8 " = 15 " "
l " = 79½ 20¼
4 " = 5 " "
4 × = 6¾
4 × = 5
displaced by Wood 240½ cub inch
also −33 = 207

414 177 cub ins air content
− 240 −33 144
174 317 cb ins [illegible]
in Circuit

8" area = 50.265 Cold Air pump [illegible]
× 4.5" stroke = 226 cub ins

226 314 (from 226 − 1/3 air) [illegible]
− 174 − 52
52 262 expansion [illegible]
314
− 85
229
72

March 16. 1880

Temperature of Room 17° C.
Exhaust air at slow speed - 64° C
" " " fast " - 69° C.

Exhaust Steam varying from 98 to 102° C.
apparently not effected during work of Air engi
Pressure in Air engine 10" Merc. & Vacuum $1\frac{1}{2}$ to
even while Exhaust heat operated but by han
slow motion was given to revol - -

With smallest addition of Steam 42 revol per
62° temperature of exhaust steam.
Add steam 60 revol - 65° - " "
" " 75 " - 68° - " "

March 17th.

Air & Steam 80 revol with condenser of
very small condensation in cyl.
" " " 80 " without " only live
very marked condensation in cyl.
" " " 32 " with condenser
very small condensation in cyl.
" " " 32 " without " only live

2780

5